

761-2

JUN 2 1930

The Effect of Adding Zinc Oxide to Iron Oxide Paints



FRANKLIN
INSTITUTE
LIBRARY

RESEARCH BULLETIN

THIS EDITION
FOR DISTRIBUTION TO
PAINT MANUFACTURERS ONLY

Issued by
The New Jersey Zinc Company

(Established 1848)

160 Front Street, New York

FRANKLIN
INSTITUTE
LIBRARY

The Effect of Adding Zinc Oxide to Iron Oxide Paints

By

HARLEY A. NELSON, M. A.

Chief of Pigment Research, Research Division
The New Jersey Zinc Co., Palmerton, Pa.



June 1929—Revised

The New Jersey Zinc Company

(Established 1848)

160 Front Street, New York

Products Distributed by

The New Jersey Zinc Sales Company

(Incorporated)

New York Chicago Pittsburgh Cleveland San Francisco



Research Laboratory, The New Jersey Zinc Company, Palmerton, Pa.

THE NEW JERSEY ZINC COMPANY
is glad to make this contribution
as a part of its work in the interests
of the paint industry.

The Effect of Adding Zinc Oxide to Iron Oxide Paints

BY HARLEY A. NELSON

INTRODUCTION

A number of efforts have been made to classify pigments as to their desirable qualities for use in priming paints for metals that are subject to corrosion. As early as 1899 Smith¹ conducted a series of experiments designed to classify pigments according to their tendencies to prevent corrosion under the paint film. With the subsequent development of the electrolytic and other theories of corrosion, investigators became increasingly interested in the probability that certain pigments could be definitely classed as inhibitors or stimulators of corrosion. The experiments described by Cushman and Gardner² represent the most extensive efforts to classify the then commercially available pigments. All of the more recent tests on metal priming paints have shown that the essential value of this information cannot be ignored, although when faced with the practicalities of paint manufacture, cost considerations or the lack of certain desirable properties in the individual pigments may limit its application.

ADVANTAGES OF ZINC OXIDE

The investigators referred to above have all ranked Zinc Oxide as a pigment with definite rust inhibitive properties. More recent work by H. Masseille³ has demonstrated the value of having zinc oxide next to the metal under such extreme conditions as on ships' bottoms. But, whatever its merits in this respect, it is also a well-known fact that zinc oxide does impart very desirable properties to paint films. We may refer especially to the increased toughness and abrasive resistance of the film; the increase in original gloss and the greater gloss retention, as well as the marked decrease in the chalking of paints in which it is present.

These advantages are at once apparent in finish coat paints and are too well known to need further elaboration at this time. However, the ad-

¹Smith, J. Soc. Chem. Ind., Dec. 30, 1899, page 1094.

²Corrosion and Preservation of Iron and Steel, page 169.

³H. Masseille, Department of Works of French Navy, Port of Toulon: Notes on the oxidation of metal hulls and the means of preventing them from rust: Part II, Causes that facilitate the oxidation of metal hulls (use of zinc oxide distemper as a preventative), Peintures, Pigments, Vernis. Vol. I, No. 8, pages 3-6, August, 1924.

vantages gained by using zinc oxide in the common metal priming paints are not so fully established, and it is the object of this paper to show how zinc oxide can be used in common types of metal priming paints to make high grade products of paints that otherwise can only be classed, at best, as mediocre from a service standpoint.

Iron oxide is available in unlimited quantities at a comparatively low cost, and possesses a number of very desirable qualities which have made it popular for use on wood and metal surfaces. When used alone for priming purposes it has certain weaknesses which, if they have been recognized, are probably ignored since these weaknesses can be corrected. Paint manufacturers and consumers, who have given considerable thought to the matter, are fully aware of the advantages to be gained by the addition of Zinc Oxide.

One of the largest of the petroleum companies, for instance, specifies that all structural steel for its extensive construction in the Far East be primed with Zinc Oxide-Iron Oxide paint. Manufactured in this country, the steel is subjected to much severe treatment during its journey of several thousand miles, including hoisting and shifting on and off trains and boats, and long and primitive haulage in the East, most of which time it is exposed to the elements. Only a very effective primer could withstand such exposure.

That the addition of Zinc is strikingly effective is indicated by the following experiments which were designed to show:

- (1) The effect of adding 15% and 25% (by weight) of zinc oxide to the pigment portion of iron oxide paints.
- (2) Whether it is essential that the zinc oxide bearing paint be placed next to the metal.
- (3) Differences between several typical iron oxides from various sources.

EXPERIMENTAL

Test Number One (Exposed March 9, 1922)

The panels used in this experiment were 12 inches by 24 inches—No. 22 gage sheets of a high grade Ingot Iron, and an O. H. Copper Steel.¹ These were sand-blasted and first painted over the entire surface with one coat of the priming paint under test. One side (the front) was then laid out in three sections, each 4 inches wide. The center section was left with only one coat of primer. The right hand section was given a second (or finish) coat of the priming paint, and the left hand section two coats of an abrasion-resistant finish paint, according to industrial plant practice.

Not only were checks run with the same primers on the two metals,

¹Containing not less than .18% copper.

but several iron oxides were chosen for comparison. These are listed in Table No. 1 as Samples Nos. 1 to 7 inclusive.

The following priming paints were made up with each iron oxide:

- (1) Pig. { 100% Iron Oxide
- (2) Pig. { 85% Iron Oxide
 { 15% XX Lead Free (American Process) Zinc Oxide
- (3) Pig. { 75% Iron Oxide
 { 25% XX Lead Free (American Process) Zinc Oxide

Ordinary raw linseed oil, turpentine and liquid drier vehicles were used.

All panels were exposed at a 45° angle facing south on a hillside overlooking an industrial plant at Palmerton, Penna. The moisture and sunlight exposure conditions were quite severe, and the tests are observed to be considerably accelerated over similar paints in use on industrial plant structures in the same locality.

The results of this test are tabulated in Table No. 2, and partially illustrated by representative photographs as shown in Figures I to VIII, inclusive, which are more fully discussed later.

Test Number Two (Exposed April 7, 1923)

This test was designed to supplement the experiment described above, and to further prove that it is essential to have the zinc oxide bearing paint film next to the metal.

Paints were prepared as above with four iron oxides (Samples 9, 10, 13 and 14, Table I), both without zinc oxide and with 15% zinc oxide. Ordinary Black Iron panels (12 inches by 24 inches—22 gage) were divided vertically in two sections.

The left-hand section was primed with the 85% Iron Oxide-15% Zinc Oxide paint. The right-hand section was primed with 100% Iron Oxide paint.

When thoroughly dried, the Iron Oxide-Zinc Oxide section was given a finish coat of paint of 100% Iron Oxide, and the straight Iron Oxide section was finished with an 85% Iron Oxide and 15% Zinc Oxide paint.

The panels were exposed at an angle of 45° facing south.

The results of this test are tabulated in Table No. 3, and partially illustrated by the photographs, Figures IX and X.

Test Number Three (Exposed April 7, 1923)

A third test was inaugurated with a series of eight iron oxides (see Table No. 1). These panels were prepared and exposed as described under

Test Number One, except that for one panel of each set the vehicle in the 85% Iron Oxide—15% Zinc Oxide paint was modified by adding 20% (by weight) of a high grade spar varnish. The results are tabulated in Table No. 4, and partially illustrated by the photographs shown as Figures XI and XII.

It should be noted that the metal panels used in this test, as well as in Test Number Two, were of a common grade black iron, which is a decidedly inferior grade of iron in rust resistance as compared with the metals used in Test Number One, described above. This should be borne in mind by the reader in comparing the differences in the types of corrosion appearing on the panels.

Presentation of Results

The panels in each test were first graded independently by two inspectors who divided them into groups according to their relative condition. For example, it was found that the panels generally fell into five distinct groups ranging from extremely or very poor to very good condition. This classification is indicated in Table Nos. 2, 3 and 4.

Panels in Figures I and II are shown in colors to aid the reader in gaining a true idea as to the existing color differences, which cannot be obtained from the ordinary photographs. The other panels photographed were further representative exhibits chosen with the object of best illustrating the effects obtained by adding zinc oxide, and the desirability of having the zinc oxide next to the metal. The panels selected for photographing are indicated in the Tables by references to the figure numbers.

TABLE NO. 1
 SAMPLES OF IRON OXIDE USED IN TESTS ON THE EFFECT OF ADDING
 ZINC OXIDE TO AN IRON OXIDE METAL PRIMING PAINT.

Sample No.	Designated	Fe ₂ O ₃	SiO ₂	Al ₂ O ₃	CaO	Total S as SO ₃	CO ₂	Remarks
1	Indian Red	98.4	18	1.2	.21	.34	.1	Roasted Copperas
2	Mineral Brown	50.4	30.8	10.6	2.4	1.87	.3	Eastern Pennsylvania Ore
3	Roasted Carbonate	66.0	21.5	10.0	.9	.4	.1	Eastern Pennsylvania Ore
4	Spanish Oxide	86.8	..	..	..	..	..	Imported Oxide
5	Persian Gulf	71.1	21.2	2.83	.25	.45	.6	Imported Oxide
6	Mixture of Canadian and Spanish	86.5	..	..	..	..	..	An Arbitrary Mixture
7	Venetian Red	53.7	6.8	21.8	2.0	1.14	.3	Roasted Bauxite Residue
8	Venetian Red	37.0	.5	.4	23.5	38.0	1.9	Roasted Copperas
9	Venetian Red	40.8	.8	.4	22.3	31.0	.5	Roasted Copperas
10	Red Oxide	96.0	2.6	1.6	.2	.25	.1	Roasted Copperas
11	Persian Gulf	70.0	23.0	4.0	1.0	.38	.6	Imported Oxide
12	Red Oxide	54.0	6	.5	17.2	23.0	.5	Roasted Copperas
13	Red Oxide	84.7	6.9	3.3	1.7	.4	.9	Spanish Oxide
14	Red Oxide	66.0	6.2	1.5	9.9	13.0	.6	Spanish Oxide let down with
15	Indian Red	98.3	.4	1.6	.2	.11	.1	Roasted Copperas

TABLE NO. 2
TEST NO. 1—EFFECT OF USING ZINC OXIDE IN THE PRIMING COAT ON
IRON AND STEEL SURFACES

Sample of Iron Oxide Used	Series	Relative Condition of Panels after 2½ Years' Exposure				
		Extreme to Very Poor†	Poor	Fair	Good	Very Good
1	6 Cu Steel 7 Ingot Iron	0% ZnO*	0% ZnO	25-15% ZnO 25% ZnO	15% ZnO	
2	6 Cu Steel 7 Ingot Iron	0% ZnO (Fig. V.)		25% ZnO	25% ZnO	15% ZnO (Fig. VI)
3	6 Cu Steel 7 Ingot Iron	0% ZnO 0% ZnO (Figs. I & III)			15% ZnO 25% ZnO	25% ZnO 15% ZnO (Figs. II & IV)
4	6 Cu Steel 7 Ingot Iron	0% ZnO 0% ZnO		15-25% ZnO 15% ZnO	25% ZnO	
5	6 Cu Steel 7 Ingot Iron		0% ZnO	0% ZnO	15% ZnO	15% ZnO
6	6 Cu Steel	0% ZnO (Fig. VII)			15% ZnO (Fig. VIII)	
7	6 Cu Steel	0-15% ZnO	25% ZnO			

*Ratios to per cent (by weight) of XX (lead free) zinc oxide used with the iron oxide in the priming coat.

†Ratings: Extremely poor, very poor, poor, medium, fair, good, very good.

TABLE NO. 3
TEST NO. 2—EFFECT OF USING ZINC OXIDE IN THE PRIMING COAT ON
IRON SURFACES

Sample of Iron Oxide Used	Panel Number	Rating of the Paints According to Their Relative Effectiveness in Preventing Corrosion			
		Extremely Poor	Very Poor	Poor	Good
9	25				Very Good
10	26	0% ZnO in Paint next to Metal. (Fig. X-B)	15% ZnO in Paint next to Metal. (Fig. X-A)	0% ZnO in Paint next to Metal. (Fig. IX-B)	15% ZnO in Paint next to Metal. (Fig. IX-A)
13	27			0% ZnO in Paint next to Metal.	15% ZnO in Paint next to Metal.
14	28			0% ZnO in Paint next to Metal.	15% ZnO in Paint next to Metal.

*Steps in rating: Extremely poor, very poor, poor, medium, fair, good, very good.

TABLE NO. 4
TEST NO. 3—EFFECT OF USING ZINC OXIDE IN THE PRIMING COAT ON
IRON SURFACES

Sample of Iron Oxide Used	Relative Condition of the Panels after 18 Months' Exposure				
	Extremely Poor †	Very Poor	Medium	Fair	Good
8		0% ZnO		15% ZnO 15% ZnO*	
9	0% ZnO		15% ZnO*	15% ZnO	
10	0% ZnO	15% ZnO 15% ZnO*			
11		0% ZnO		15% ZnO	15% ZnO*
12	0% ZnO		15% ZnO	15% ZnO*	
13	0% ZnO		15% ZnO 15% ZnO*		
14	0% ZnO (Fig. XI)				15% ZnO (Fig. XII) 15% ZnO
15	0% ZnO		15% ZnO*	15% ZnO	

*In these priming paints, 20% (by weight) of spar varnish was added to the vehicle.

†Steps in rating: Extremely poor, very poor, poor, medium, fair, good, very good.

FIGURE I
(See Page 12)

Photograph of panel No. 7 (Test Number One, Series No. 7) primed with Iron Oxide No. 3 (Roasted Carbonate), without any added zinc oxide. Rated with Group I as being in *very poor* condition (See Table No. 2).

Section "A": (One coat of priming paint.) Rusting general. Paint entirely gone.

Section "B": (Two coats of priming paint.) Rusting is general. Paint practically all disappeared from surface.

Section "C": (One coat of priming paint plus two coats of a grey finish paint.) Rusting and very badly checked and cracked.

This photograph is primarily intended to aid the reader in gaining a better idea as to the true condition of the panels as shown in the ordinary photographs that follow. It should be compared with the ordinary photograph, Figure III, and contrasted with Figure II showing a colored photograph of the same iron oxide with 15% zinc oxide added.

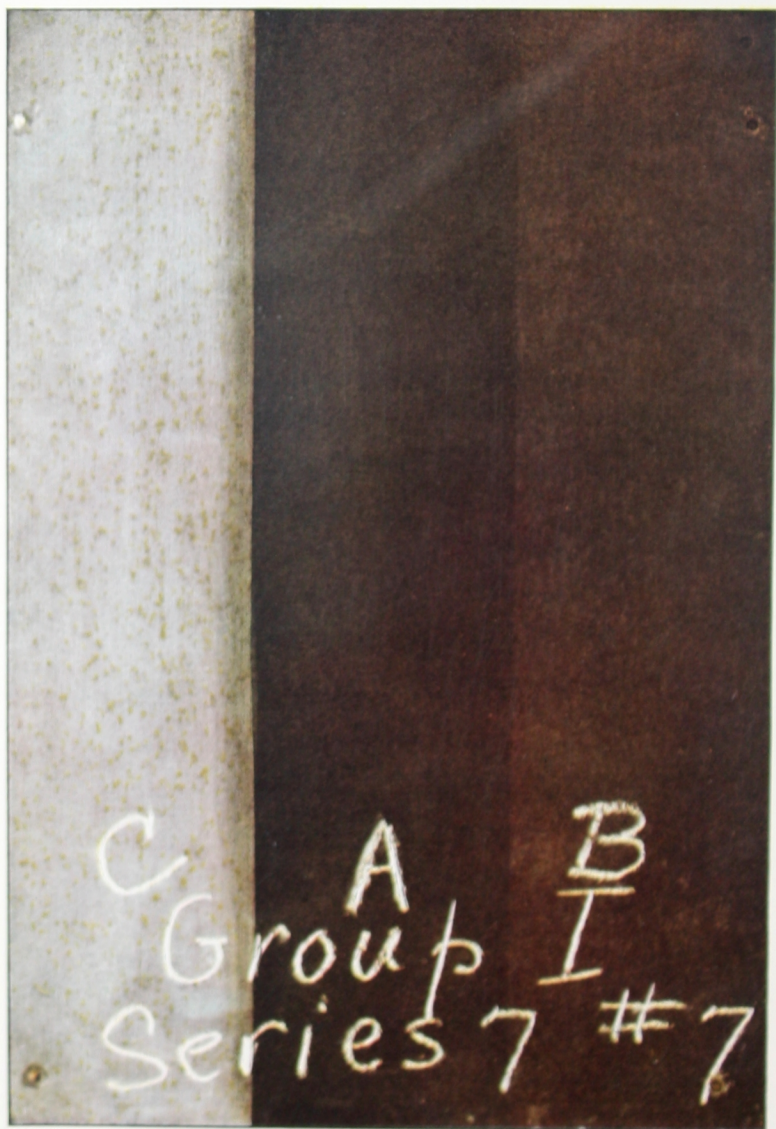


FIGURE I
COLORED PHOTOGRAPH OF GROUP I, SERIES 7, No. 7
(See page 11)

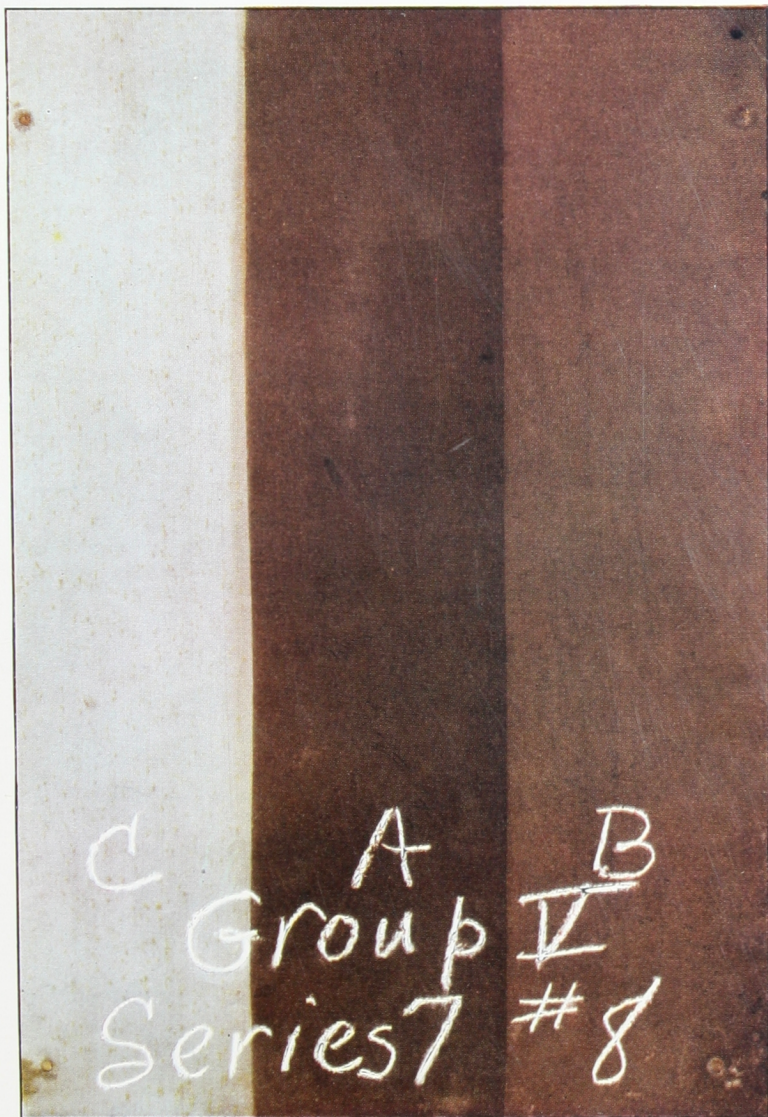


FIGURE II
COLORED PHOTOGRAPH OF GROUP V, SERIES 7, NO. 8
(See page 14)

FIGURE II

(See Page 12)

Photograph of panel No. 2 (Test Number One, Series No. 7) primed with Iron Oxide No. 2 (Rounded Carbonate) with 15% (by weight) XX "American Process" Zinc Oxide added to the pigment portion of the paint. Rusted with Group V as being in *very good* condition (see Table No. 2).

Section "A": (One coat of priming paint.) Rusted areas cover possibly 50% of surface.

Section "B": (Two coats of priming paint.) A few very small localized rust pits can be seen under microscope. Paint film in excellent condition.

Section "C": (One coat of priming paint plus two coats of a grey finish paint.) Very slight evidence of rust coming through the paint film. Some checking and very slight cracking of finish coat.

This photograph is intended to further assist the reader in getting at a true comparison of the condition of the paints with and without added zinc oxide. It is typical of the panels in Group V and should be contrasted with Figures I and III, showing the same iron oxide without zinc oxide added.

FIGURE III
(See page 16)

Photograph of panel No. 7 (Test Number One, Series No. 7) primed with Iron Oxide No. 3 (Roasted Carbonate) without any added zinc oxide. Rated with Group I as being in *very poor* condition (see Table No. 2).

This is a photograph of the same panel shown in Figure I, and is intended to illustrate the ordinary photographic reproduction of the colors. The photograph should be contrasted with Figure IV, showing the same iron oxide with 15% Zinc Oxide added.

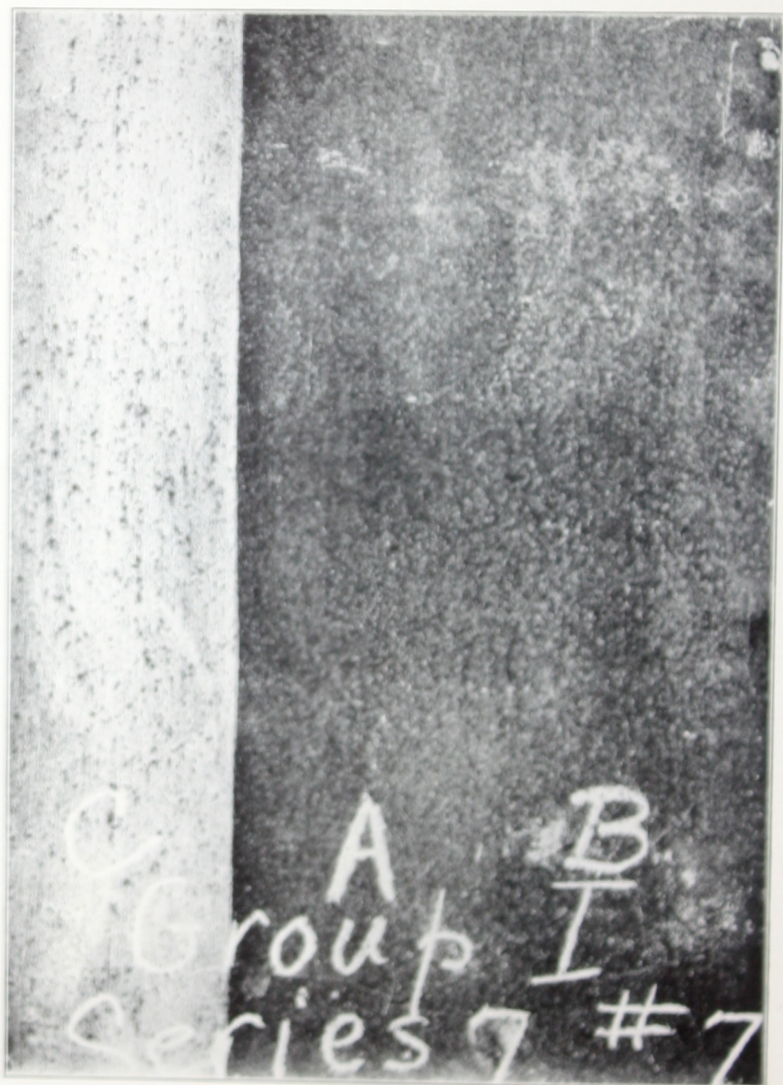


FIGURE III
(See page 15)

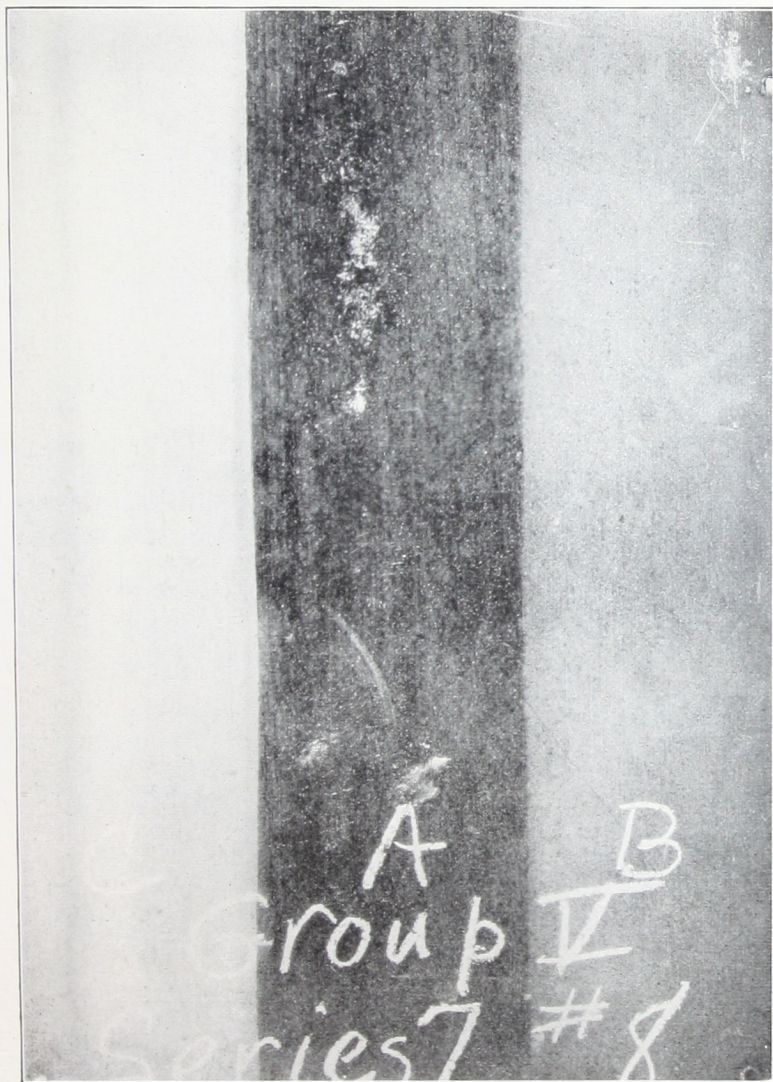


FIGURE IV
(See page 18)



FIGURE IV
(See page 17)

Photograph of panel No. 8 (Test Number One, Series No. 7) primed with Iron Oxide No. 3 (Roasted Carbonate) with 15% (by weight) XX "American Process" Zinc Oxide added to the pigment portion of the paint. Rated with Group V as being in *very good* condition (see Table No. 2).

This is a photograph of the same panel as Fig. II. It should be contrasted with Fig. III, showing the same iron oxide without zinc oxide added.

FIGURE V
(See Page 20)

Photograph of panel No. 4 (Test Number One, Series No. 6) primed with Iron Oxide No. 2 (Mineral Brown) without zinc oxide. Rated with Group I as being in *very poor* condition (see Table No. 2).

Section "A": (One coat of priming paint only.) Badly rusted and paint all gone.

Section "B": (Two coats of priming paint.) Badly rusted and paint practically all gone.

Section "C": (One coat primer and two coats of a grey finish paint.) Badly spotted with rust pits. Severe checking and cracking over entire surface.

This photograph should be contrasted with Figure VI. The panel is in the same general condition as Fig. I and Figure III, and direct comparisons of these photographs should be made to get the significance of the darker areas on the ordinary photographs.



FIGURE 5
(See page 10)

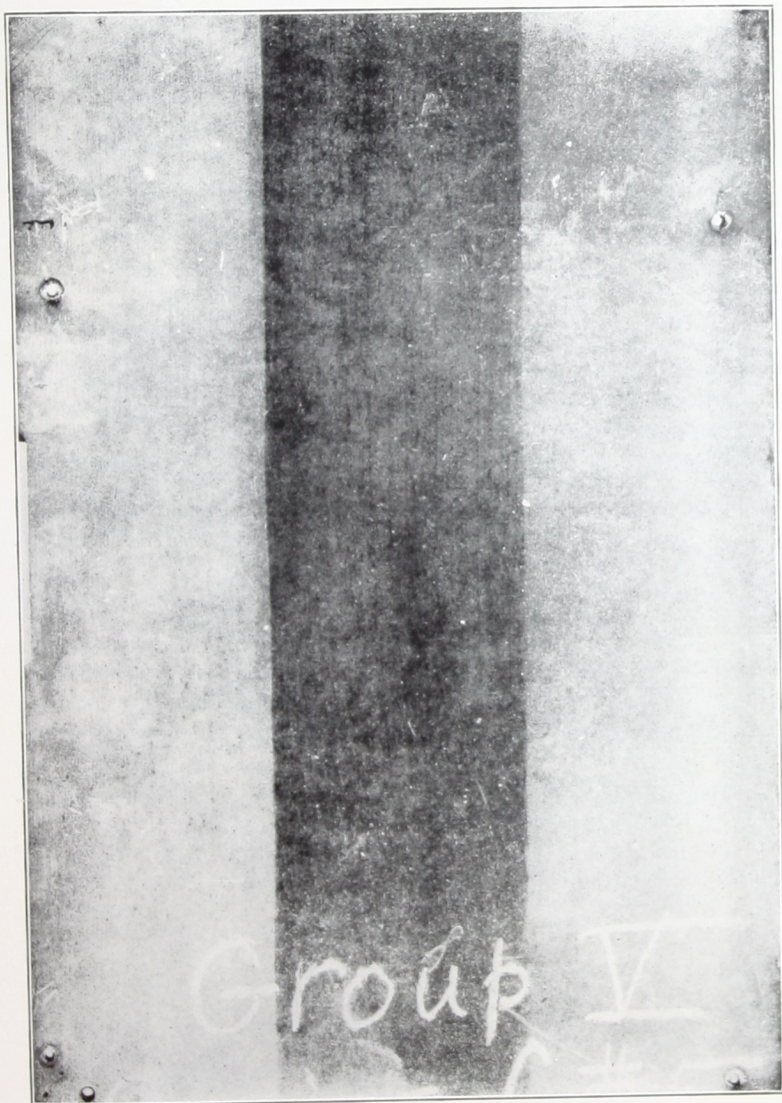


FIGURE VI
(See page 22)

FIGURE VI
(See page 21)

Photograph of panel No. 5 (Test Number One, Series No. 6) primed with Iron Oxide No. 2 (Mineral Brown) with 15% (by weight) XX "American Process" Zinc Oxide. Rated with Group V as being in *very good* condition (see Table No. 2).

Section "A": (One coat of priming paint.) Rusting through film in spots but over 50% of paint film intact and still giving protection to the metal. Note absence of extreme color contrasts between Sections "A" and "B".

Section "B": (Two coats of priming paint.) A very few localized rust spots. Film in excellent condition.

Section "C": (One coat of primer plus two coats of grey finish paint.) A few localized rust spots showing through the paint film. Slight checking of the grey finish coat. In excellent condition.

This photograph should be contrasted with Figure V, showing the same iron oxide without zinc oxide added.

FIGURE VII
(See Page 24)

Photograph of panel No. 13 (Test Number One, Series No. 7) primed with Iron Oxide No. 6 (mixture of Canadian and Spanish) without zinc oxide. Rated with Group I as being in *very poor* condition (see Table No. 2).

Section "A": (One coat of priming paint.) Badly rusted and paint entirely gone.

Section "B": (Two coats of priming paint.) Badly rusted and paint almost entirely gone.

Section "C": (One coat of primer and two coats of a grey finish paint.) Badly spotted with rust pits. Severe checking and cracking over entire surface.

This photograph should be contrasted with Figure VIII, which shows the same iron oxide with 15% Zinc Oxide added.



FIGURE VII
(See page 23)



FIGURE VIII
(See page 26)

FIGURE VIII

(See page 25)

Photograph of panel No. 14 (Test Number One, Series No. 7) primed with Iron Oxide No. 6 (mixture of Canadian and Spanish) with 15% (by weight) XX "American Process" Zinc Oxide. Rated with Group IV as being in *good* condition (see Table No. 2).

Section "A": (One coat of priming paint.) Considerable rusting, but some of the paint film remains.

Section "B": (Two coats of priming paint.) Some rusting through the film, but, generally, the film is in good condition.

Section "C": (One coat of primer and two coats of a grey finish paint.) Some rust coming through the paint film. Very little checking and cracking of the grey finish coat paint.

This photograph should be contrasted with Figure VII showing the same iron oxide without zinc oxide added.

FIGURE IX
(See Page 28)

Photograph of panel No. 25 (Test Number Two) with Iron Oxide No. 9 (Venetian Red) as follows: (See Table No. 3.)

Section "A": (Priming coat containing 15% (by weight) XX "American Process" Zinc Oxide; second coat is same iron oxide without any zinc oxide.) Note absence of any rust pits on this surface. Film in excellent condition throughout. Rated as being in *very good* condition.

Section "B": (Priming coat contains no zinc oxide; second coat contains 15% Zinc Oxide as described above.) Note prevalence of rust pits on Section "B", some of which have developed extensively. The paint film is breaking down rapidly. Rated as being in *poor* condition.

This photograph illustrates results with a good grade of iron oxide (compare with Figure X).

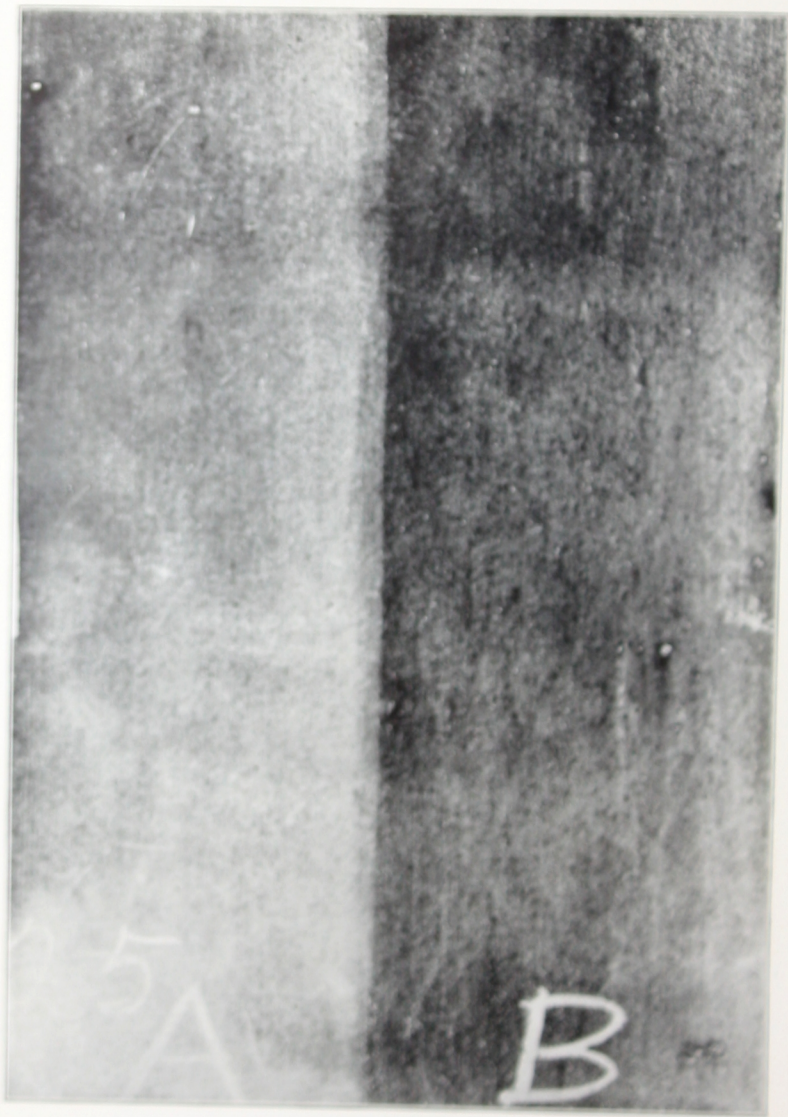


FIGURE IX
(See page 27)



FIGURE X
(See page 30)

FIGURE X
(See Page 29)

Photograph of Panel No. 26 (Test Number Two) primed with Iron Oxide No. 10 (Red Oxide) as follows: (See Table No. 3.)

Section "A": Primed with a paint containing 15% (by weight) XX "American Process" Zinc Oxide; second coat is same iron oxide without any zinc oxide added. Rated as being in *very poor* condition.

Section "B": Primed with a paint containing no zinc oxide; second coat contains 15% (by weight) XX "American Process" Zinc Oxide. Rated as being in *extremely poor* condition.

This photograph illustrates results with a very inferior grade of iron oxide (compare with Figure IX).

The deep, pitted type of corrosion should be contrasted with the type found in Figures I to VII where the deep pits are never observed. The ordinary black iron used in Tests Number Two and Number Three (exposed 18 months) is very inferior to the metals used in Test Number One (exposed 2½ years) as can easily be seen from the photographs here presented. The importance of selecting a good iron for new construction work which is to be protected by painting certainly deserves emphasis.

FIGURE XI
(See Page 32)

Photograph of panel No. 19 (Test Number Three) primed with Iron Oxide No. 14 (Red Oxide) without any zinc oxide. Rated as being in *extremely poor* condition (see Table No. 4).

Section "A": (One coat of priming paint.)

Section "B": (Two coats of priming paint.)

Section "C": (One coat of priming paint plus two coats of a grey finish coat paint.) Note the extreme checking of the finish coat paint.

This photograph should be compared with Figure XII showing the same iron oxide with zinc oxide added.

The attention of the reader is again called to the pitted type of corrosion which is typical of the ordinary black iron used in Test Number Three.



FIGURE XI
(See page 31)



FIGURE XII
(See page 34)

FIGURE XII

(See Page 33)

Photograph of panel No. 20 (Test Number Three) primed with Iron Oxide No. 14 (Red Oxide No. 1234) with 15% (by weight) XX "American Process" Zinc Oxide added to the pigment portion. Rated as being in *good* condition (see Table No. 4.)

Section "A": (One coat of priming paint.) Rust pits cover possibly 20% of surface. Some of paint still giving protection to metal.

Section "B": (Two coats of priming paint.) A very few localized rust spots are beginning to appear. Film generally in excellent condition.

Section "C": (One coat of priming paint plus two coats of grey finish paint.) Some localized rust spots. Only slight checking of the finish coat.

This photograph should be compared with Figure XI showing the same iron oxide without zinc oxide added.

DISCUSSION OF RESULTS

The outstanding fact brought out by the tests is that in every case, without a single exception, the addition of zinc oxide has greatly improved the quality of the priming paints. The inspection data indicates that the useful life of the paint films has at least been doubled, and in some cases increased even more.

Examination of the panels shows that this improvement becomes evident in at least two important respects. First, it has either greatly reduced or practically eliminated the tendency to pitting due to corrosion under the priming film; second, it has decreased the tendency of the finish paint to check and alligator.

The first of these can, of course, only be ascribed to definite increase in the protective quality of the film, whether this is due to inhibitive properties of zinc oxide itself, to a neutralization of acidic compounds in the film by zinc oxide, or to a general increasing of the imperviousness of the paint film to gasses and moisture. The results of Test Number Two, especially, emphasize the necessity for having the zinc oxide in the film next to the metal.

The universal decrease in the checking of the finish paints over the zinc oxide bearing films can be ascribed to the well known hardening action of zinc oxide. This is in accord with the generally accepted principle that, if checking and alligatoring are to be avoided, the priming paint must not remain softer than the coats subsequently applied.

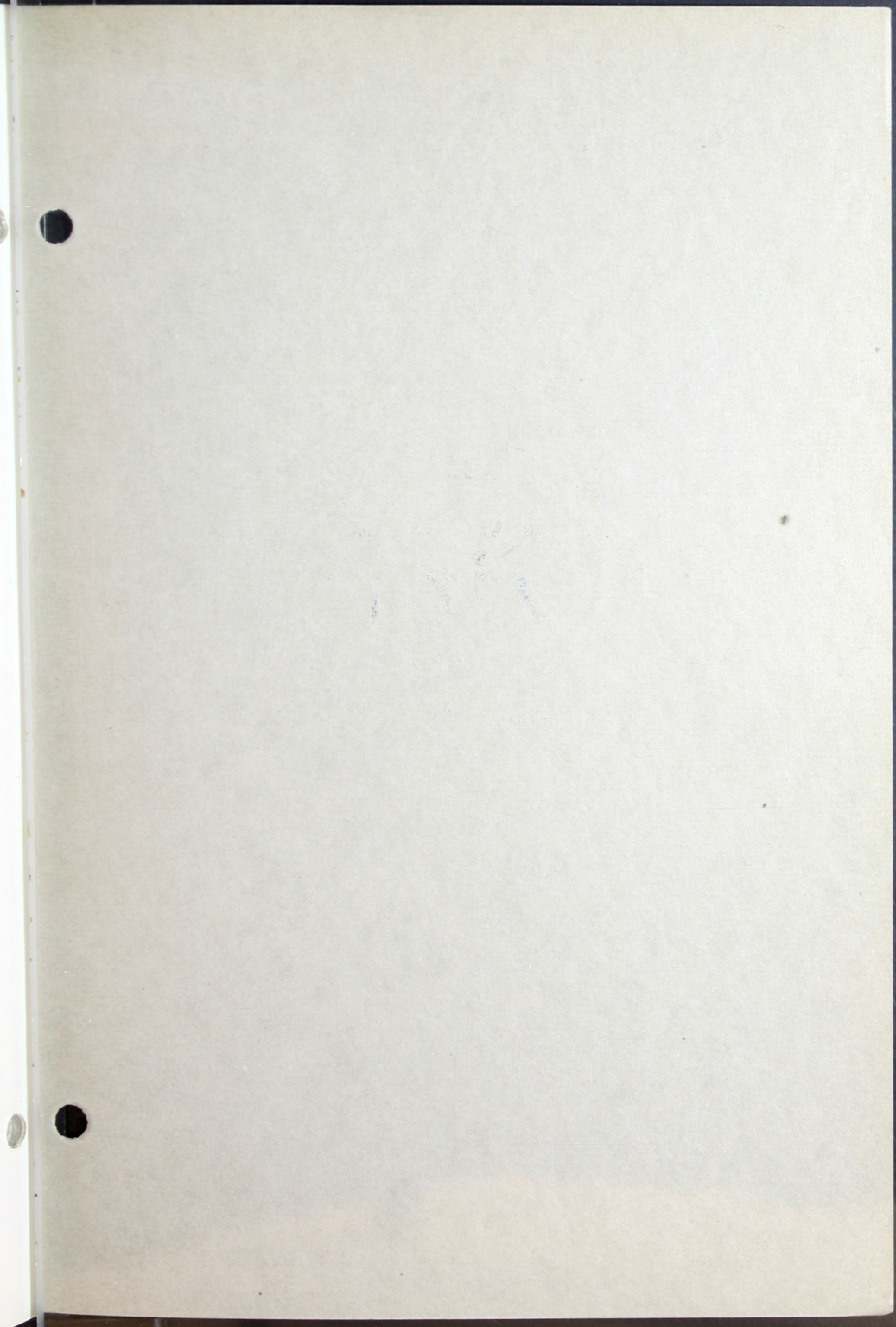
Except in the case of the Venetian Red (Panel No. 7) the relative advantage of adding more than 15% zinc oxide to iron oxides is not at all proportionate to the improvement up to 15% zinc oxide. It seems probable that the optimum amount of zinc oxide, for most practical purposes, is from 15% to 20% (by weight) of the pigment portion of the paint.

Except in a few individual cases, the differences between the iron oxides themselves are not of the same order of magnitude as the differences in quality introduced by adding zinc oxide. If any conclusions are to be drawn concerning the iron oxides they would be: (1) that the very high $\text{Fe}^{2+}\text{O}^{3-}$ bearing iron oxides (Indian Reds) are not suited for use in metal priming paints; (2) that even a moderately high $\text{Fe}^{2+}\text{O}^{3-}$ content may not, in itself, be an indication of outstanding properties for use in metal priming paints; (3) that, while individual Venetian Reds may give fair results, as a

class these should not be used in general-purpose metal priming paints; (4) that the domestic ore pigments are probably as good as the imported iron oxides, and especially so if they are used with zinc oxide.

The striking differences between the nature of the corrosion observed on the irons used in these tests deserves repeated emphasis. The important fact is that, aside from greater original resistance to corrosion, the high grade ingot iron and the O. H. copper steel have both corroded uniformly and without the deep pitting observed throughout on the ordinary black iron. Every man charged with maintenance of painted structural iron work will at once appreciate the real monetary saving represented by the greater ease with which surfaces that corrode uniformly, as shown in Figures I to VIII, inclusive, can be cleaned and prepared for repainting. It is true that these observations are limited to sheets, and that the degree to which the results apply in the case of structural shapes is not known. However, it would seem unreasonable to expect a reversal, and the relatively greater importance of the service expected from structural shapes, their usually greater inaccessibility for cleaning, and the general difficulties encountered in replacing them, are additional arguments for selecting the best.

For other interesting points brought out by the photographs, the reader is referred to the discussion appearing with the individual photographs.





The World's Standard for Zinc Products